ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

Douglas A. Ducey
Governor

Misael Cabrera
Director

via e-mail

October 16, 2017
FPU18-086

Ms. Catherine Jerrard
AFCEC/CIBW
706 Hangar Road
Rome, NY 13441

RE: WAFB – ADEQ comments - *Draft, Soil Vapor Extraction System/Steam Enhanced Extraction System, Operation and Maintenance, 2016 First Quarter Performance Report, Former Liquid Fuels Storage Area, Site ST012, Former Williams Air Force Base, Mesa, Arizona*; prepared for Air Force Civil Engineer Center (AFCEC/CIBW), Lackland AFB, TX; prepared by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec), Phoenix, AZ; document dated August 29, 2017.

Dear Ms. Jerrard:

Arizona Department of Environmental Quality (ADEQ) Federal Projects (FP) personnel and ADEQ contractor UXO Pro, Inc. reviewed the above referenced document. ADEQ's comments are presented below and on following pages.

General Comments

GC 1: ADEQ remains concerned that contaminants mobilized during Steam Enhanced Extraction (SEE) remedial activities were not captured and may have migrated away from the site. In addition, data collected during the time period of the report indicate a significant mass of contaminant remained within the thermal treatment zone. ADEQ communicated a recommendation to continue SEE, or at a minimum, after steam injection ceased, to continue vapor and liquid extraction from the treatment zone for an extended period of time (i.e., months or years) until total contaminant mass removal rates and extracted benzene concentrations decreased to levels consistent with the transition criteria for enhanced bioremediation (EBR).

GC 2: The criteria for transitioning from SEE to EBR provided in Table 4-2 of the May 2014 Work Plan have not been met despite the assertions made in Section 3.3.1.6 of the subject report. Two criteria are diminishing mass extraction rates (less than 10% of peak rates during SEE) and benzene groundwater concentrations less than 500 µg/L. As of the end of the reporting period, neither of these criteria has been demonstrated nor have indications of achieving these criteria in the near future as described in the specific comments. Insufficient data have been provided regarding benzene concentrations and assertions that significant mass is being extracted from outside the TTZ are unsubstantiated by reliable data. Until further progress is demonstrated, discussion of transitioning to EBR is premature.

GC 3: The report states, "The cycling of the water table associated with pressure cycling influences LNAPL recovery, as some fluctuation in weekly LNAPL production is evident." This statement suggests a sustained period of liquid extraction attempting to maximize drawdown is a more effective LNAPL recovery strategy than pressure cycling once the site is heated. It is recommended this strategy (months or years of extraction) be followed after steam injection at the site is ceased

Specific Comments

1. Page 1-3, Section 1.3.1, Line 261. Please edit the text to read "removed approximately 344,000 gallons of fuel contamination."
2. Page 2-8, Table 2-6. Please provide an explanation for the discrepancy between the influent concentration and the FID and PID readings. The average laboratory influent concentration TPH as JP-4 is reported in Table 2-2 to increase from 2,750 ppmv in the previous quarter to 4,500 ppmv in the reporting period. However, the wellfield oxidizer influent average VOC concentration based on FID and PID readings reported in Table 2-6 indicate a roughly one-half concentration reduction.
3. Page 2-10, Section 2.2.1.1, line 556. Please edit the typographical error.
4. Page 2-10, Table 2-7. Please consider adding a column for the average extraction rate from open wells.
5. Page 2-12, Section 2.2.1.1, line 589. Please discuss the reported concentrations of CO2, O2 and methane presented in Table 2-7. The text is incomplete and it appears text has been inadvertently deleted.
6. Page 3-10, Section 3.2.1.2.1, line 1010. Please discuss whether continuous logs of vapor flow rate from the wellfield are available. The text states "Vapor flow rate is continuously logged at the vapor extraction blower discharge to monitor the wellfield vapor extraction rate." However, line 1017 states, "The wellfield flow rate is calculated by taking the daily average flow rate to the thermal accelerators and subtracting the air stripper effluent flow rate to estimate the vapor flow from the wellfield."
7. Page 3-11, Section 3.2.1.2.1, line 1027. Please explain why a pitot tube was not installed to directly measure the wellfield flow exiting the vapor cooling process. The text states the accuracy of the calculated wellfield flow rate diminished to the point that calculated values were known to be incorrect. This discrepancy was attributed to the accuracy of the pitot tube measurements. As commented upon below, the vapors from the wellfield carried a vast majority of the non-NAPL mass extracted during this period making direct measures of the wellfield flow and concentrations of primary importance for evaluating SEE performance.
8. Page 3-15, Section 3.2.1.2.4. The same section of the previous Annual Report states "Beginning the first quarter of 2015, recovered LNAPL will be sampled on a monthly basis…" Please provide a discussion and lab reports for any LNAPL samples that were analyzed during the reporting period.
9. Page 3-30, Section 3.2.1.3.3. In addition to the acknowledged variability in the calculated concentrations attributed to flow measurement errors and to a lesser extent on variability in the feedwater concentration, the text should also mention the variability in the analytical results for the concentrations. Laboratory data are only accurate to about +/-30% and only reported to two significant digits. The utility of the method used to calculate benzene concentrations is questionable and certainly qualitative. As evidenced by the calculation of negative values, the calculated concentrations are unreliable and cannot be used to support the transition from SEE to EBR. Further, both sampling events were performed during steam injection when dilution water was being introduced into the subsurface. Higher concentrations would be expected during the depressurization cycles. Measures of the benzene concentration in the air stripper influent provide a more consistent and reliable indicator of cleanup progress.
10. Page 3-30, Section 3.2.1.3.3. On the right side of the equation, $C_{formation}$ should be replaced with C_{return}.

11. Page 3-32, Section 3.2.1.4. Please include a discussion of the pump intake depths in relation to the water table drawdown in the jar test wells. The discussion of the MPE well jar testing is qualitative and provides little value in assessing system performance. For example, a relatively deep pump placement can allow a very large volume of LNAPL to collect at the water table surface with very little LNAPL extraction by the pump.
12. Table 3-7. Please include the missing monthly data for well U02.
13. Page 3-45, Section 3.2.3, line 1346. Please explain how cycling the educator skids on a daily basis was optimal compared to operating all six skids simultaneously when mass removal is achieved through extraction and common sense indicates maximizing the extraction rate maximizes the mass removal rate.
14. Page 3-50, Section 3.3.1.1. Please include a more detailed discussion regarding the reliability of the thermocouples and associated effects on the interpretation of subsurface temperatures. As discussed during BCT meetings during the reporting period, many of the thermocouples utilized to calculate average subsurface zone temperatures were erratic and many readings were unreliable. With respect to progress toward attaining remedial goals, attaining target temperatures is a prerequisite for desired SEE performance but is not an indicator of SEE duration to attain remedial goals.
15. Page 3-57, Section 3.3.1.2. As stated in lines 1495-1497, changes in vapor concentrations associated with site-wide pressure cycling are not evident in the data presented. The discussion should include a statement that attainment of this criterion for EBR transition is inconclusive. As discussed during BCT meetings during the reporting period, pressure cycling has a very limited technical basis for sustained increases in vapor concentrations of volatile hydrocarbons such as benzene when the majority of the mass remains in the LNAPL phase rather than dissolved in water. The data as presented substantiate this technical expectation for LNAPL sites.
16. Page 3-58, Section 3.3.1.2, line 1511. Unless a technical basis or other technical data are provided, delete the sentence, "LNAPL may have been traveling from outside the TTZs to perimeter MPE wells with the in-rush of water when steam injections ceased and the larger delay in March may indicate that much of the LNAPL contributing to the peak LNAPL removal originated from further outside the TTZs." No credible monitoring occurred to indicate which zones or wells produced LNAPL during operations; as commented above, the MPE well jar testing provides little value in assessing system performance. The preceding sentence states LNAPL recovery is related to travel time to MPE wells. Travel time is related not only to separation distance but also drawdown (pressure gradient), soil permeability, LNAPL and water viscosities at local soil temperatures, and NAPL saturation distribution.
17. Page 3-59, Section 3.3.1.2, line 1519. Unless a technical basis or other technical data are provided, delete the phrase, "as LNAPL is pulled into the TTZs from outside." As indicated in the preceding comment, the origin of the recovered LNAPL is unknown because insufficient data have been collected.
18. Page 3-59, Section 3.3.1.2, line 1520. Delete the phrase, "The lack of significant response in the vapor phase satisfies completion of the pressure cycling criterion." The pressure cycling criterion states, "The process of building and releasing the pressure will be repeated until no additional significant increases in effluent vapor phase concentrations occur when steam pressure is reduced." This criterion has not been satisfied as no initial increase has been observed. The pressure cycling criterion makes no mention of LNAPL mass removal rates in its description for satisfaction.
19. Page 3-62, Section 3.3.1.3, Line 1573. Please edit the sentence to read, "Mass removal (combined LNAPL and vapor at the thermal accelerators) peaked on 14 May 2015 based on PID readings." Please add a sentence describing the peak mass removal rate based on analytical data and a comparison of this value to rates calculated for the current period. No evaluation has been provided describing the quality of correlations between PID readings and analytical data. Site decisions should rely upon certified analytical data.

20. Page 3-62, Section 3.3.1.3, Line 1576. Please delete the sentences that read, "The remaining mass removal is primarily from outside the TTZs based on the LNAPL recovery response during pressurization/depressurization (LNAPL recovery decreased during steam injection and had a delayed increase following steam cessation). Continued steam injections would not significantly increase mass removal from inside the TTZs and only inefficiently remove further mass from outside the TTZs. Given data indicating a condition of diminishing returns despite the contribution of mass from outside the TTZs, the mass removal criteria has been met at 12% of peak mass removal." As described in specific comments 15 and 16 and during BCT meetings, the monitoring at the site is insufficient to determine the location of origin for recovered mass during the reporting period. A definitive statement asserting the mass originates from outside the TTZ cannot be substantiated.
21. Page 3-63, Section 3.3.1.3, Line 1585. Delete lines 1585 and 1586.
22. Page 3-63, Section 3.3.1.4 and Table 3-12. Please revise Table 3-12 to include all of the benzene data from the reporting period and re-write the section based on the full data set available. The benzene data summarized in Table 3-12 appears to be incomplete with respect to the available analytical data. Other analyses have been provided for air stripper influent samples collected during the reporting period and were included in Table 3-4. In addition, the benzene concentration from the sample of 21 March 2016 is 3,600 µg/L in Table 3-4 rather than 960 µg/L as shown in Table 3-12. Using the full set of data, the average benzene concentration in the reporting period is 2,382 µg/L rather than 1,243 as shown in Table 3-12.
23. Page 3-64, Section 3.3.1.4. Delete the final paragraph. As described in previous comments, the methodology employed to obtain qualitative estimates of benzene concentrations in extraction wells is unreliable and insufficient monitoring exists to assess the origin of extracted mass. Therefore, no statement can be made regarding the satisfaction of the benzene concentration criteria for transitioning to EBR.
24. Page 3-64, Section 3.3.1.6, Line 1626. Delete pressure cycling from the sentence as the data are inconclusive as described in a previous comment.
25. Page 3-64, Section 3.3.1.6. Please add a sentence describing the cumulative volume of water extracted during SEE in comparison to the expected quantity based on the design.
26. Page 3-64, Section 3.3.1.6, Line 1630. Delete the phrase, 'however, it has been shown that the primary reason these targets have not been achieved is related to mass extracted from outside the TTZs". As described in previous comments, insufficient data exist to make this claim.
27. Page 3-64, Section 3.3.1.6, Line 1637. Delete the final sentence of the paragraph as it has not been shown that SEE has met the overall transition criteria goal.
28. Page 3-65, Section 3.3.1.6. Delete Lines 1648 through 1672 for the reasons provided in previous comments. The majority of the assertions are unsubstantiated or based on unreliable data.
29. Page 3-66, Section 3.3.2.1. Provide quantitative support for using a mass balance on water to assess containment during steam injection. As described in a previous ADEQ memo and in discussions during BCT meetings, a mass balance on water is inadequate to assess containment during steam injection, a multi-phase process. Steam vapors displace liquid water from soil pore space and this displaced water must be accounted for in assessing containment. Further, to maintain containment, the extensive heterogeneity at the site necessitates a ratio far in excess of one for the extraction rate compared to the injection rate, after accounting for displaced groundwater and natural groundwater flow. Operational periods occurred when the extraction rate was less than the injection rate and the steam zone was allowed to grow outward for a time. In addition, each of the zones above and below the LSZ should be evaluated separately for containment given the minimal hydraulic communication between the two. The pressure gradients associated with this outward growth can mobilize LNAPL outward; however, the subsequent pressure gradients when the extraction rate increased (or steam injection rate decreased) are much, much smaller and unlikely to mobilize the LNAPL back in.

Closure

ADEQ may add or amend ADEQ comments if evidence to the contrary of our understanding is discovered; if received information is determined to be inaccurate; if any condition was unknown to ADEQ at the time this document was submitted or electronically delivered; if other parties bring valid and proven concerns to our attention; or site conditions are deemed not protective of human health and the environment within the scope of this Department.

Thank you for the opportunity to comment. Should you have any questions regarding this correspondence, please contact me by phone at (602) 771-4121 or e-mail miller.wayne@azdeq.gov.

Sincerely,
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ADEQ Project Manager, Federal Projects Unit
Remedial Projects Section, Waste Programs Division

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